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The Optical Orientation of Synthetic Anorthite

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With 2 figures in the text

Abstract. New data on the optical orientation of synthetic anorthite are presented. These do not agree with those of DUPARC-GYSIN (1926) and TERTSCH (1942), and are better in line with the extrapolated values for natural plagioclases.

The optical orientation of synthetic anorthite was investigated by DUPARC et GYSIN in 1926 and by TERTSCH in 1942. Though the specimens examined differed, the data given by these authors show good agreement. BURRI-PARKER-WENK in their compilation on the optical orientation of the plagioclases (1967) had, therefore, to consider the mean values of the two independent determinations as representative of the pure end member, An 100. This procedure was adopted with some reluctance, because the position angles of these synthetic anorthites are not in line with those of an end member of the series; they fit volcanic plagioclases with about 90—93% anorthite. In the compositional range An 93 to 95 the optical orientation of volcanic plagioclases is well documented by eight different observations which give closely coinciding data (see part 4 by R. L. PARKER and H. R. WENK in the above cited compilation). The available values allowed the deduction of the position angles of natural high-temperature plagioclase An 95. On all migration curves of BURRI-PARKER-WENK this well-established standard An 95 occupies an extreme position; the line connecting An 95 with the retrograde point An 100 was stippled in all diagrams.

Until recently it was hard to find natural plagioclases with An > 95, suited for a joint chemical and optical analysis. The possibilities of the electron microprobe improved the situation considerably and recent work on anorthites from metamorphic rocks of the Alps and of South India (WENK, E., SCHWANDER, H. and TROMMSDORFF, V., 1967) indicates that pure anorthite must have an optical orientation different from

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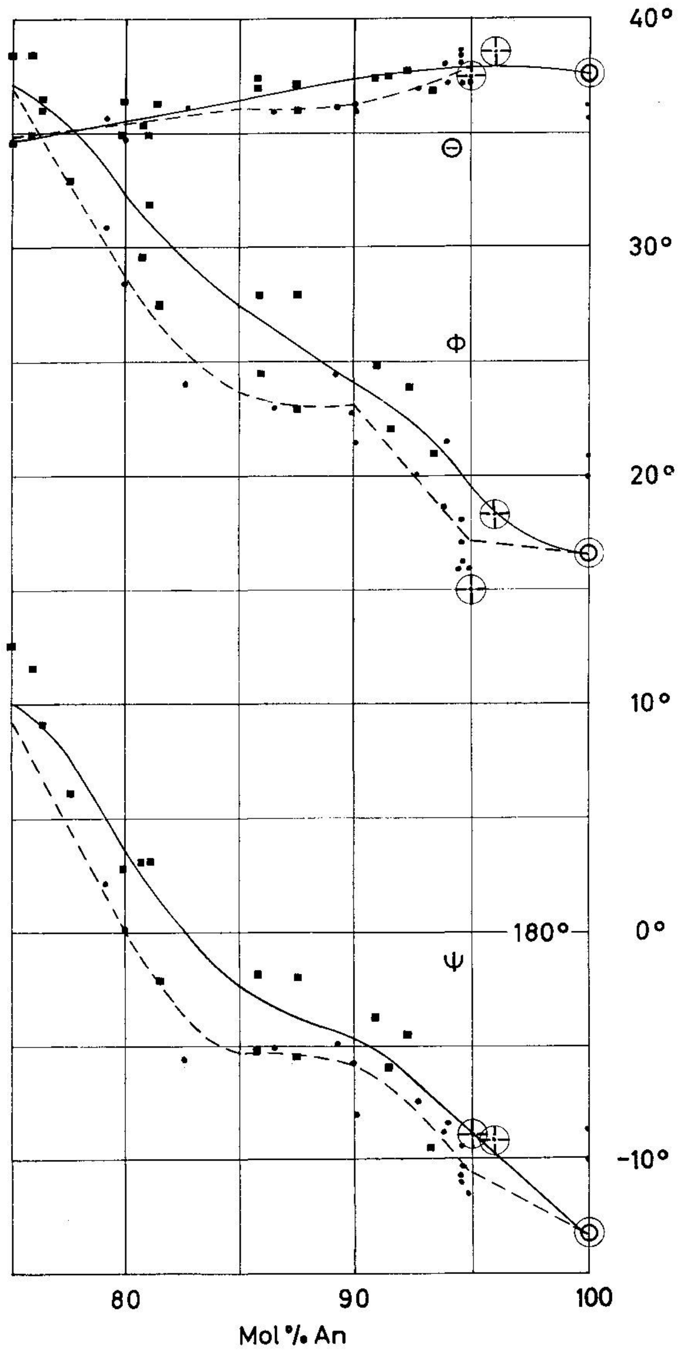

Fig. 1. Diagram showing the variation of the Eulerian angles I in relation to the anorthite content An 75—95 after Burri, Parker and Wenk 1967. (Dots and broken lines refer to volcanic, crosses and full lines to plutonic plagioclases.) The positions of the new synthetic anorthite (double circles) and of two anorthites from metamorphic rocks (circled crosses; Wenk, Schwander and Trommsdorff 1967) are shown.

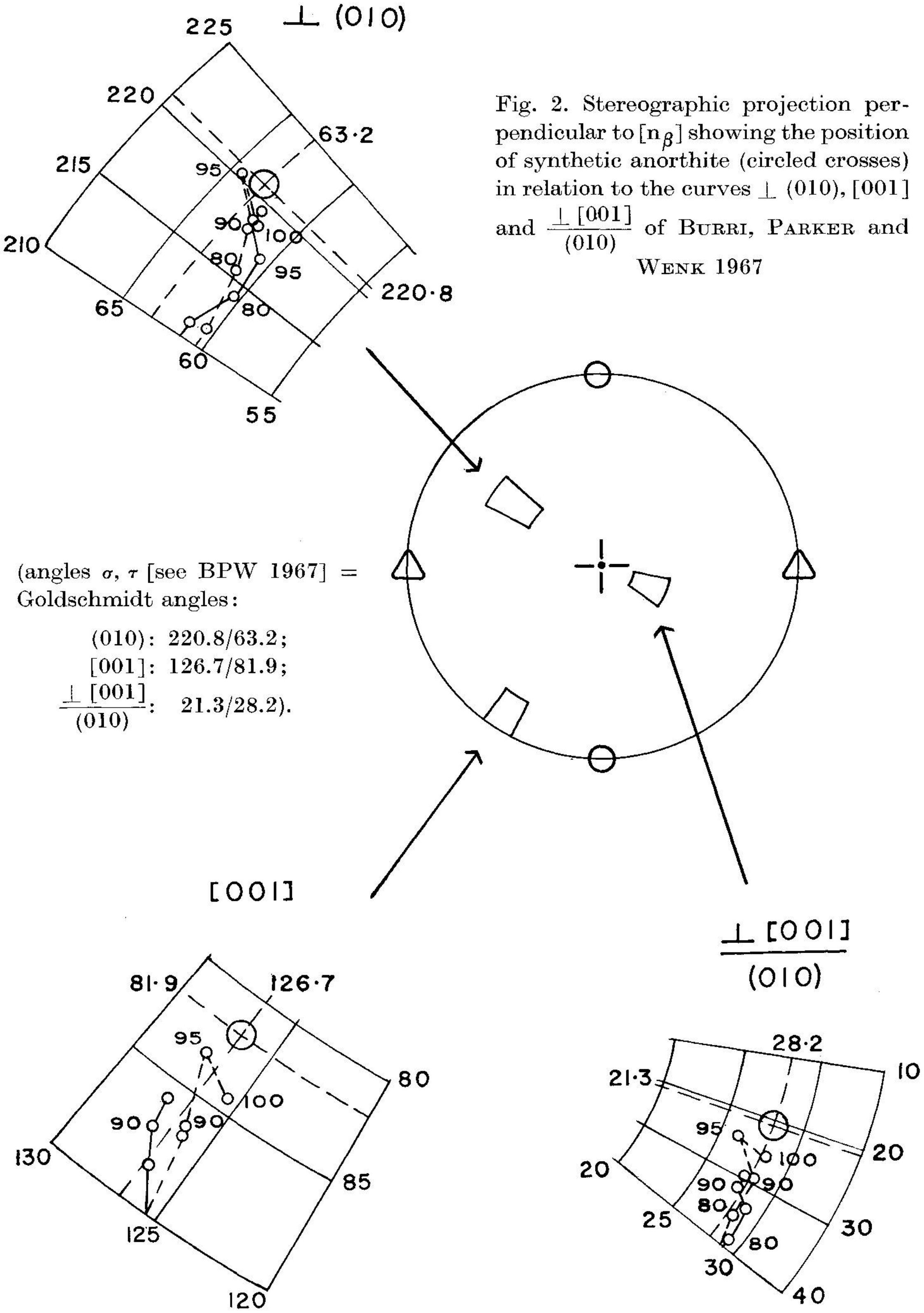

Fig. 2. Stereographic projection perpendicular to [n_β] showing the position of synthetic anorthite (circled crosses) in relation to the curves ⊥ (010), [001] and $\frac{\perp [001]}{(010)}$ of Burri, Parker and Wenk 1967

(angles σ, τ [see BPW 1967] = Goldschmidt angles:

(010): 220.8/63.2;
[001]: 126.7/81.9;
$\frac{\perp [001]}{(010)}$: 21.3/28.2).

the data published on synthetic anorthite. Theoretically all pure anorthites should be in an ordered structural state.

In the meantime H. Schwander, Basel, has been able to synthesise the pure end member of the plagioclase series in large grains well suited for an optical study (see Fig. 3 and 4 in H. Schwander and E. Wenk, 1967).

An albite twin (0.45×0.35 mm) showing cleavage after (001) in both individuals gave the following Eulerian angles (E. W.):

PHI $16.5° \pm 0.5°$ THETA $36.5° \pm 1°$ PSI $14.2° \pm 1.5°$ $2\,V_\gamma$ $106° \pm 2°$

A more direct and reliable approach was given by an albite-Carlsbad complex-twin (Roc Tourné) 0.4×0.75 mm, measured by two investigators (E. W. and V. T.):

		PHI	THETA	PSI	$2\,V_\gamma$
E. W.	Ind. 1	16°	38.5°	−13.5°	
	Ind. 2	17°	38.5°	−13°	
					105° ± 3°
V. T.	Ind. 1	15.5°	37°	−14°	
	Ind. 2	17.5°	37°	−12°	

The mean values of these five series of data

ϕ $16.5° \pm 1°$ θ $37.5° \pm 1°$ ψ $-13.3° \pm 1°$ $2\,V_\gamma$ $105 \pm 3°$

are evidently much better in line with the position of a pure end member than the data found by Duparc et Gysin and Tertsch. We do not doubt the measurements of these experts, but only the quality of their specimens.

Figures 1 and 2 show the position of the new synthetic anorthite compared with the data from the above-mentioned compilation work.

From the given Eulerian angles I the following additional position angles were derived by computer:

Anorthite An 100 (synthetic) 12/1/67

1. Projection perpendicular to [001]

Eulerian angles II

R 117.1	I 98.1	L_α 53.3	LA 15.7

Eulerian angles III

D 33.1	N 53.7	K_α 100.0

Goldschmidt angles φ, ρ

$[n_\alpha]$	$[n_\beta]$	$[n_\gamma]$	A	B
196.5/37.5	297.1/81.9	33.1/53.7	204.9/74.4	111.8/8.1

Becke angles λ, φ*

$[n_\alpha]$	$[n_\beta]$	$[n_\gamma]$	A	B
12.3/−35.6	81.0/26.8	−36.6/42.4	56.4/−60.8	−7.5/−2.9

Köhler angles		$[\alpha\alpha]$	$[\beta\beta]$	$[\gamma\gamma]$	AA	BB
Albite-Karlsbad law	X	160.1	56.4	127.8	132.2	165.0
Albite law	Y	108.7	126.2	95.0	58.3	174.1
Karlsbad law	Z	75.0	163.9	107.3	148.8	16.2

	$[n_\alpha]$	$[n_\beta]$	$[n_\gamma]$	A	B
Projection on (001), ζ, η	308.6/53.6	208.7/77.0	102.5/39.5	298.8/89.9	338.9/19.7
Projection on (010), δ, ϵ	192.3/54.3	80.9/63.2	323.4/47.5	236.5/29.1	172.5/87.0
Projection perpendicular to [100] μ, ν	132.4/59.9	330.2/31.3	227.0/82.1	175.8/61.2	93.2/71.1

Projection perpendicular to $[n_\beta]$, σ, τ

[001]	$\frac{\perp [001]}{(010)}$	[010]	[100]	$\frac{\perp [100]}{(010)}$
126.7/81.9	21.3/28.2	225.0/60.7	74.7/31.3	318.6/75.0
(001)	(010)	(100)	(110)	$(1\bar{1}0)$
322.4/77.0	220.8/63.2	23.1/31.2	31.9/59.5	304.6/8.1
(021)	$(0\bar{2}1)$	$(\bar{2}01)$		
179.3/81.3	275.1/60.3	86.9/37.0		

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